PATENT CLAIMS

1. Flowmeter having at least two ultrasonic transducers (2, 3), which are mounted on a containment (7), through which a medium (9) is flowing in a stream direction (S), wherein the ultrasonic transducers (2, 3) alternately send and receive ultrasonic measuring signals in, and against, the stream direction (S), and having a control/evaluation unit (6), which, on the basis of the travel time difference of the ultrasonic measuring signals propagating in, and against, the stream direction (S), determines and/or monitors the volume flow rate of medium (9) in the containment (7),
characterized in that
the ultrasonic transducers (2, 3) are constructed such that they send and receive ultrasonic measuring signals, or sonic fields, with a large opening angle (γ), i.e. a large beam spread.

2. Apparatus as claimed in claim 1,
characterized in that
the two ultrasonic transducers (2, 3) are arranged in a defined separation (L) from one another, wherein the separation (L) of the two ultrasonic transducers (2, 3) is dependent only on the opening angle (γ) of ultrasonic measuring signals, or the sonic fields, and wherein the separation (L) of the two ultrasonic transducers (2,3) is independent of other system- and/or process-parameters (w, cr, c, di).

3. Apparatus as claimed in claim 2,
characterized in that
a minimum separation ($Lmin$) of the two ultrasonic transducers (2, 3) is dimensioned such that the ultrasonic measuring signals, which are alternately sent from, and received by, the two ultrasonic transducers (2, 3), in each case propagate along at least one sonic path (SP1, SP2) in the containment (7) through which the medium (9) is flowing.

4. Apparatus as claimed in claim 3,

characterized in that
the minimum separation ($Lmin$) of the two ultrasonic transducers (2, 3) and the opening angle (γ) of the ultrasonic measuring signals, or sonic fields, is dimensioned such that the ultrasonic measuring signals propagate along at least two sonic paths (SP1, SP2), which differ in the number of traverses (n), wherein a traverse defines the section of a sonic path SP1, SP2, along which an ultrasonic measuring signal crosses once through the containment 7.

5. Apparatus as claimed in claim 4,
characterized in that
the control/evaluation unit (6), on the basis of the travel time ($t(n)$) of the ultrasonic measuring signals, which propagate along at least two different sonic paths (SP1, SP2) in, and against, the stream direction (S) in the containment (7) through which the medium (9) is flowing, calculates at least one of the system- or process parameters (w, cr, c, di) necessary for determining the volume flow rate of the medium (9) in containment (7).

6. Apparatus as claimed in claim 5,
characterized in that
the at least one system- or process parameter is the inner diameter (di) of the containment (7), the wall thickness (w) of the containment (7), the velocity of sound (cr) in the material of which the containment is fabricated, or the velocity of sound (c) in the medium (9).

7. Apparatus as claimed in claim 1,
characterized in that
each ultrasonic transducer (2, 3) has at least one piezoelectric element (4, 5) as a sending- and/or receiving element.

8. Apparatus as claimed in claim 7,
characterized in that

the piezoelectric element (4, 5) is a disc-shaped piezoelectric element, with which an acoustic diverging lens or an acoustic lens is associated for the purpose of beam spreading.

9. Apparatus as claimed in claim 7,
characterized in that
multiple piezoelectric elements (4, 5) are provided as sending- and/or receiving elements, wherein the sending- and/or receiving elements are arranged in an array.

10. Apparatus as claimed in claim 9,
characterized in that
the control/evaluation (6) controls the piezoelectric elements (4, 5) in the array such that the predetermined beam spread, i.e. the desired opening angle (γ), is achieved.